TRAINING RANGE SITE CHARACTERIZATION AND RISK SCREENING

REGIONAL RANGE STUDY, JEFFERSON PROVING GROUND, MADISON, INDIANA

Final

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Prepared by

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EXECUTIVE SUMMARY

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SEPTEMBER 2002

1 REFERENCES

Appendix A provides a list of general references used in this document. Specific media references are provided in their respective sections.

2 AUTHORITY

The U.S. Army Environmental Center (AEC) has requested that the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) examine several military ranges at JPG for their potential impact (contamination) on soil, ground water, surface water, and sediment resources and plant and stream biota.

3 PURPOSE

To conduct a limited focus investigation of the potential munitions constituents impact of normal, live-fire range training operations at the former Army range of Jefferson Proving Ground. This investigation is to consider ground water, soil, surface water, and sediments. To conduct a screening level human health risk assessment based on U.S. Environmental Protection Agency (USEPA) methods using the data collected from each of the environmental media.

To conduct an ecological assessment, including a site-specific evaluation of biological resources (if necessary) and potential ecological impacts of chemical data collected for each of the environmental medial. This investigation is intended as an assessment of residuals in soil and water and not as an occupational study.

This investigation was conducted using a JPG Quality Assurance Project Plan (QAPP) (See Appendix G). The QAPP was developed in accordance with the *Draft Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), October 2002*, prepared by the Intergovernmental Data Quality Task Force[1] (IDQTF), a federal consensus organization to document and control sampling and analysis procedures for this project.

[1] The U.S. Environmental Protection Agency established the Intergovernmental Data Quality Task Force (IDQTF), chaired by the Director, Federal Facilities Restoration and Reuse Office (FFRRO) to address environmental data quality issues across governmental organizations. The IDQTF operates as a partnership, reaching decisions through consensus. While membership in IDQTF is open to any federal agency/department, current consensus members include representatives from the Department of Defense, the Department of energy, and the U.S. environmental Protection Agency.

4 SUMMARY OF FINDINGS

4.1 GROUND WATER

Eight monitoring wells (four in Impact Field 5.3 E, three in Impact Field 3W, and one in the Delta Impact Area) were installed in the surficial aquifer underlying the study area. The wells were installed to collect ground-water quality and ground-water elevation data. In order to better define ground-water conditions in the study area, ground-water quality and elevation data were also collected from seven pre-existing wells. Based on ground-water elevation data, shallow ground water in the study area appears to follow topography.

Ground-water samples were collected from all wells and were analyzed for one or a combination of the following: 15 explosive compounds (explosives and their degradation compounds), 14 metals, depleted uranium, perchlorate, hardness, and total dissolved solids. Due to low recovery rates in some of the pre-existing wells, a full suite of sample analysis could not be completed for each well. All wells were sampled and the samples were analyzed for explosive compounds. Fourteen wells were sampled for perchlorate. Metals samples from twelve wells were collected and analyzed. Samples collected from 13 wells were also analyzed for hardness and dissolved solids.

No explosive compounds or perchlorate were detected in any ground-water sample. Antimony, cadmium, chromium, mercury, silver, and zinc were not detected in any sample. Arsenic, barium, copper, lead, and total uranium were detected in samples collected from one or more wells at concentrations below their respective primary or secondary MCL. Manganese was detected in the majority of samples collected from wells screened in the overburden at concentrations above the secondary MCL and above the mean background concentration. Manganese concentrations in samples collected from wells screened in bedrock were below the secondary MCL. Calcium concentrations exceed the mean background concentration; there is no MCL for calcium. The high concentrations of manganese and calcium in ground water are most likely a result of the parent material of the overburden in the area. Other metals detected in ground water are molybdenum, nickel, and vanadium. Reported concentrations of molybdenum, nickel, and vanadium are below their respective background concentrations; there are no MCLs for these metals.

4.2 SOILS

Approximately 170 soil samples were collected from seven study sites and a reference area.

For the majority of the 13 metal parameter samples that were collected and analyzed, proportions and concentrations of metals in the study sites were not significantly greater than in the reference site.

Four metals, antimony, copper, vanadium, and barium, were significantly greater than the reference in one or more study sites.

None of the metals data sets exceeded the human health screening criteria.

Of the explosives analyzed, only RDX and perchlorate were distributed throughout the impact area. The 99th percentile concentrations for these parameters were less than the human health risk screening criteria.

4.3 SURFACE WATER AND SEDIMENTS

Surface water, sediment, and benthic macroinvertebrate samples were collected from all the significant creeks at JPG from 7-11 October 2002. Creeks were sampled near the entrance and exit points to the installation, and near the midpoint to be closer to the source of possible contamination. A total of eighteen sample sites were sampled from six different stream basins. Samples were analyzed for selected metals and explosives constituents.

4.3.1 Collective Upstream Reference Sampling Locations

Since there was no upstream reference location for two of the watersheds (Middle Fork Creek and Marble Creek), the results from the six reference locations in the other watersheds were averaged to develop a reference background for the metals. This reference value was used to determine if munitions compounds and firing range activities may have impacted surface water quality. Three explosives compounds, HMX, RDX, and 2,4,6-TNT were detected in the upstream sediment samples at higher concentrations than the downstream localities.

4.3.2 Middle Fork Creek Sampling Locations

Based on the surface water, sediment and biological data collected from Middle Fork Creek, the munitions constituents and firing range activities in the Middle Fork Creek drainage basin did not appear to adversely affect the basin's surface water quality or benthic ecology. There was an increase in several surface water total metals concentrations at sampling location 13 (midstream), but these concentrations were back to reference values at the downstream sampling location 01. There were several increases in sediment metals concentrations over reference values at both sampling locations.

4.3.3 Big Creek Sampling Locations

Based on the surface water, sediment and biological data collected from Big Creek, the munitions constituents and firing range activities in the Big Creek drainage basin did not appear to adversely affect the basin's surface water quality or benthic ecology. There was an increase in surface water total lead, manganese, and zinc at the downstream sampling location and an increase in surface water total and dissolved uranium at both midstream and downstream sampling locations. At the mid stream sampling location there was an increase in metals sediment concentrations over reference values but all returned to background values by the time Big Creek exited the installation.

4.3.4 Marble Creek Sampling Location

Based on the surface water, sediment and biological data collected from Marble Creek, the munitions constituents and firing range activities in the Marble Creek drainage basin did not appear to adversely affect the basin's surface water quality or benthic ecology. Marble Creek surface water and sediment results were almost entirely below reference values.

4.3.5 Little Graham Creek Sampling Locations

Based on the surface water, sediment and biological data collected from Little Graham Creek, the munitions constituents and firing range activities in the Little Graham Creek drainage basin did not appear to adversely affect the basin's surface water quality or benthic ecology. Most of the surface water metals results were below reference values. The sediment metals results indicated that the majority of the metals increased over the watershed reference values but only four of the twelve were higher than the average reference values at the furthest downstream sampling location.

4.3.6 Graham Creek Sampling Locations

Based on the surface water, sediment and biological data collected from Graham Creek, the munitions constituents and firing range activities in the Graham Creek drainage basin did not appear to adversely affect the basin's surface water quality or benthic ecology. The surface water results indicated an increase in a few of the metals at the midstream sampling location (16) but none were substantial when considering variability between duplicate and split samples and reference locations. There were no substantial increases in sediment metals concentrations compared to reference values.

4.3.7 Otter Creek Watershed Sampling Locations

Based on the surface water, sediment and biological data collected from Otter Creek, the munitions constituents and firing range activities in the Otter Creek drainage basin did not appear to adversely affect the basin's surface water quality or benthic ecology. None of the surface water metals increased substantially in downstream locations compared to reference locations. Most of the metals sediment concentrations increased in midstream locations compared to reference values. However, only arsenic, barium chromium, and zinc remained substantially higher at the furthest downstream location (06).

4.4 HUMAN HEALTH RISK ASSESSMENT

Environmental field sampling conducted within the former firing points and impact areas at Jefferson Proving Ground indicated several metals and explosives were present in site soils. The substances detected in a relatively high percentage of the samples were antimony, arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, silver, uranium, vanadium, perchlorate, and RDX. Using the sampling data collected, the 95% upper confidence limit of the arithmetic mean was calculated for each substance. These values were used as exposure point concentrations to represent average conditions that an individual may be

exposed to over the entire site. Site-specific risk-based screening values were then derived and the risk evaluation was performed by comparing these with the exposure point concentrations for each substance. Screening levels were also derived evaluating dermal absorption of chemicals in surface water. A risk screening for surface water was conducted in a similar manner except the maximum detections of each compound were used as the exposure point concentrations. Each stream was evaluated separately since they could represent discrete areas of exposure.

4.5 ECOLOGICAL RISK ASSESSMENT

Ecological risk assessment was conducted on the basis of rodent sperm analysis, vegetation sampling and a review of the soil sample results. Two study sites and a comparison area were assessed. A total of 80 rodents were trapped and 24 adult males were sacrificed for sperm and organs. Approximately 50 vegetation samples were collected.

The sperm count in *M. pennsylvanicus* was reduced on the impact area study sites. Since the comparison site was more contaminated than the impact area sites, the cause of these reductions are probably not chemically mediated. In addition, the observed reductions in count are below the assumed 80% reduction threshold required before reproductive effects are seen.

M. pennsylvanicus had a lesser incidence of abnormal sperm (morphology) on the DU area than the comparison area, and a greater incidence of abnormal sperm on the HE area than on the comparison area. The lack of consistency in results (increased abnormal sperm on comparison site as compared to HE site) and the fact that the comparison site is more contaminated than impact area sites indicate that the observed abnormalities are due to factors other than chemical stressors. In addition, the observed differences were well below the 4% morphologic difference needed to cause a reproductive effect.

The result trend for sperm motility was similar to sperm morphology (more motile sperm were observed from animals taken from the HE area than on the comparison site, and fewer motile sperm were observed in DU animals than on the comparison site). The lack of consistency in results and the fact that the comparison site is more contaminated than impact area sites indicate that the observed differences in motility are due to factors other than chemical stressors. In addition, the observed differences were well below the 40% difference needed to cause a reproductive effect.

The fact that the comparison area was more contaminated than the impact area sperm counts were reduced on the less contaminated impact areas, the lack of consistency in morphology and motility results, and that any differences seen in sperm parameters did not exceed established thresholds, indicate that rodent populations at JPG are not being negatively impacted by substance of potential concern (SOPC) contamination.

Organ to body weight ratios did not indicate that rodents are exposed to SOPC's

Histpopathological evaluation did not indicate any chemically mediated changes in the histopathology of the organs collected from *M. pennsylvanicus*.

Hazard quotients for rodents and raptors did not exceed one on the impact area, indicating these receptors are not at risk due to SOPC exposure.

5 CONCLUSIONS

5.1 GROUNDWATER

Ground-water sample results show no evidence of ground-water contamination from the past use of munitions or the presence of UXO in the study area.

5.2 SOILS

5.2.1 The sample results indicate the presence of minor amounts of copper, RDX, and perchlorate in the JPG range areas and suggest that these are the result of range activities.

5.2.2 Based on the data collected during sampling, the SOPC's detected in soil within the former range area would not be expected to present a health risk to site workers or recreational users (hunters). All of the exposure point concentrations evaluated were well below the calculated site-specific screening levels.

5.3 SURFACE WATER AND SEDIMENTS

5.3.1 There were no exceedances of Federal Water Quality Criteria or State Water Quality Criteria in the surface water. There were a few sediment quality benchmarks exceeded in the sediment results, to include reference locations. The explosives compounds HMX, RDX, and 2,4,6-TNT were detected at very low levels in the sediment samples to include the reference locations. The aquatic benthic macroinvertebrate community was not adversely impacted by any of the munitions constituents.

5.3.2 Based on the data collected during sampling, the SOPC's detected in surface water within the former range area would not be expected to present a health risk to site workers or recreational users (hunters). All of the exposure point concentrations evaluated were well below the calculated site-specific screening levels.

5.4 HUMAN HEALTH RISK ASSESSMENT

Based on the sampling data collected during this study, the SOPC's detected within the former range area would not be expected to present a health risk to site workers or recreational users. The analytical data were evaluated and used to calculate 95% UCL's for each compound detected at levels above background. These values were then used as the exposure point concentrations, or the average site values that receptors would likely be exposed to. As a point of comparison, site-specific screening levels were developed that evaluated dermal contact,

inhalation, and ingestion of soil. Another set of screening levels were calculated for dermal contact with surface water. These screening levels were meant to evaluate a typical receptor's exposure based on what information is available regarding site usage patterns. A direct comparison indicated that all of the calculated exposure point concentrations were below the site-specific screening levels. This indicates that a health risk would not be expected for the receptors evaluated.

5.5 ECOLOGICAL RISK ASSESSMENT

Based on the weight of evidence obtained during the study, it appears that the small mammal population at JPGis not being affected by munitions constituents attributable to test artillery range operations.